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DEPARTMENT OF FISH AND GAME
MARINE RESOURCES REGION

A RE-SURVEY OF THE MARINE ENVIRONMENT OFFSHORE FROM POINT LOMA, SAN DIEGO COUNTY

by

Staff
Inshore Fisheries Habitat, Evaluation and Monitoring Project

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A RE-SURVEY OF THE MARINE ENVIRONMENT OFFSHORE FROM POINT LOMA, SAN DIEGO COUNTY [1/]

INTRODUCTION

The California Department of Fish and Game and the State Water Quality Control Board (through Regional Board No. 9 - San Diego) entered into an agreement 1 July 1970, whereby Department biologist-divers would resurvey the marine environment off the western shore of Point Loma, San Diego County, California. The investigation was to consist of a comparison of present conditions to those found in 1965 (Turner, Ebert and Given, 1968). This information would then be used by the Board to evaluate environmental changes (if any) which have occurred following the operation of the Point Loma ocean outfall.

Determinations to be made at each station included, but were not limited to: (i) the number and diversity of plant and animal life; (ii) substrate characteristics; and (iii) physical conditions of the water.

The Board reimbursed the Department for part of the expenses incurred during the course of this investigation.

AREA DESCRIPTION

The general area has remained unchanged since described in the previous report (Turner, et al., 1968) (Figure 1). Some man-made modifications of the intertidal zone at Transects II and III have occurred, resulting from an attempt to slow erosion at these locations. The most obvious change offshore appears to have been an increase in the extent of the beds of giant kelp, (Macrocystis pyrifera). This change is at least partially due to an extensive effort to control sea urchin populations in the area by Kelco, a commercial kelp harvesting company.

1/ Prepared at Marine Resources Laboratory, 350 Golden Shore, Long Beach, California 90802.

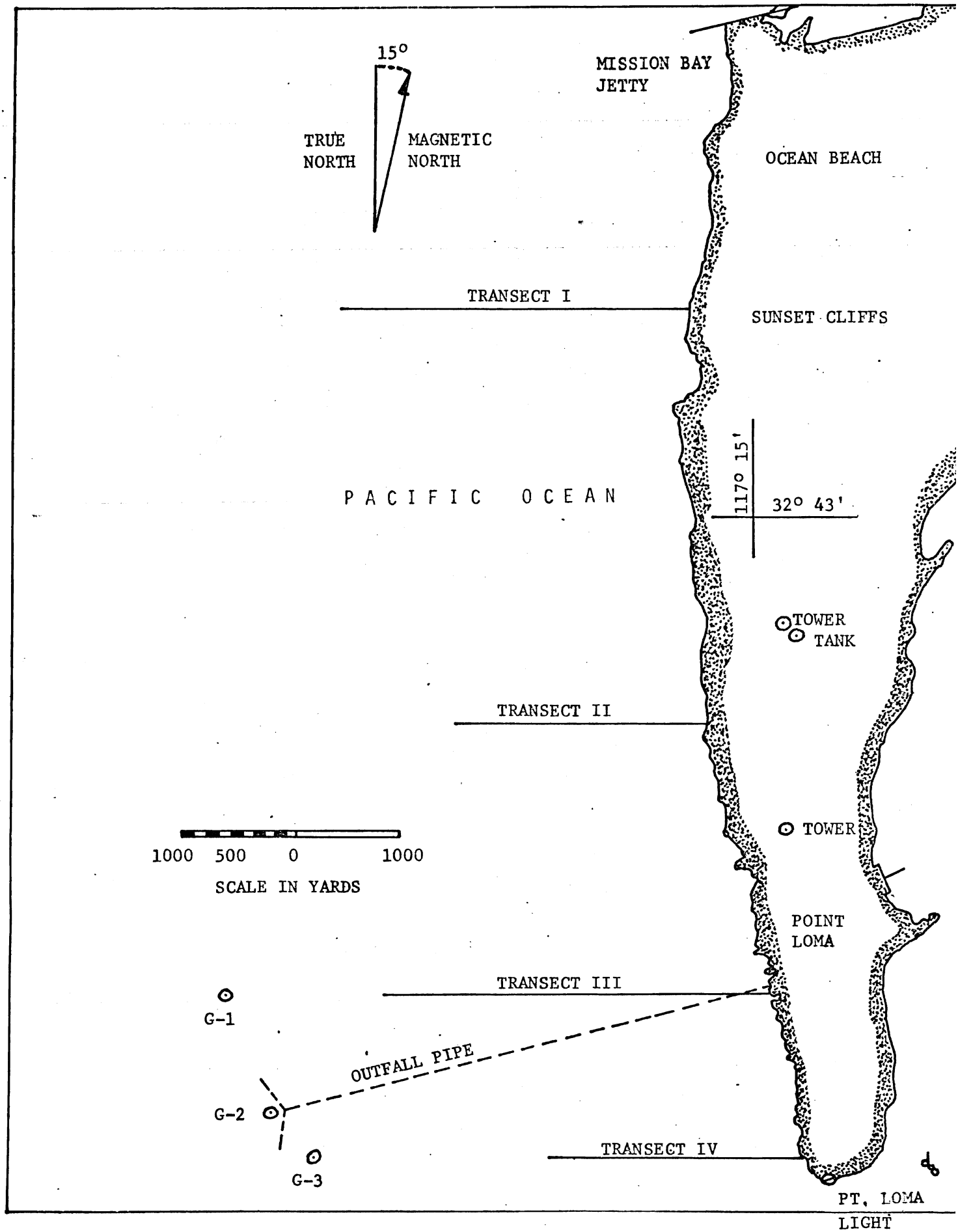

Figure 1. Location chart, transects surveyed and offshore collection sites, Pt. Loma, San Diego County.

METHODS

The field work was conducted during June, 1971. The same methods of transect and station location used in the 1965 survey (Turner, et al., 1968) were employed.

Offshore operations were conducted from the Department's 92-foot research vessel Kelp Bass, and from a 16-foot skiff. Biologist-divers made observations at 20-foot depth increments along each transect to a maximum depth of 100 feet. Each benthic station was defined by attaching a 2.2 m line to the station marker and inscribing a 15 m^2 arc. All methods and transect locations were as exact a duplication of those previously employed as possible.

Sampling conducted at each 15 m^2 station included (with modifications as the situation dictated): (i) a substrate sample for polychaetes and other micro-invertebrates; (ii) water depth; (iii) water temperature; (iv) estimation of water clarity; (v) general description of the bottom area; (vi) quantitative enumeration of the biota within the arc study area; (vii) quantitative sampling (by removal) of the biota within a 1/16 square meter quadrat; (viii) photographs at each station for a permanent record of the appearance of the station; and (ix) enumeration by estimation of the larger plants and animals found extralimitally.

Intertidal observations were made utilizing a transect and quadrat method. The transect line was laid perpendicular to shore across the intertidal zone and relative abundance of plants and animals 0.5 m to either side of the line was noted. A 1/16 square meter quadrat collection was made at the midpoint of the transect.

Three extralimital benthic samples were collected with a 1/20 square meter Ponar grab along the 220-foot depth contour near the outfall terminus.

FINDINGS

Intertidal

The intertidal portions of the transects were surveyed from shore on June 3, 15 and 16, 1971. Transects I and IV appeared relatively unchanged from the previous physical description, however, Transects II and III show modification from construction. A large concrete and wood retaining wall has been constructed at Transect II to protect the Naval Electronic Laboratory's sea-water pumping station from wave erosion. A rocky rip-rap protective barrier has been added to the base of the outfall pumping station where Transect III originates. Both of these changes have modified the intertidal environment and thus may affect the biota present at each station.

Transect I, the most northerly of the transects, began at the base of a steep sloping promontory bordered by pocket beaches. The transect crossed a moderate (90-foot) intertidal zone before dropping off abruptly onto a gently sloping offshore shelf.

The high, unprotected intertidal promontory presents a harsh environment open to direct wave action. Thirteen algae and one marine flowering plant were recorded at this station (Table 1). Of these the green sea moss (Enteromorpha sp.), and the hardier coralline algae dominated the flora. At the seaward end of the promontory, a large bed of surf grass (Phyllospadix torreyi) was observed. This station reflects an increase in the numbers of algal species, and the bed of surf grass was not previously recorded. A total of 40 invertebrate taxa was recorded along the transect, an increase from the six previously recorded. This increase is also reflected in the quadrat sample, where 26 taxa were recorded, as compared to two in the previous survey.

Transect II begins at the base of a concrete and wood retaining wall

TABLE 1. Plants and Animals Recorded Intertidally, Point Loma, June 3, 15 and 16, 1971

Scientific name	Transect and abundance *				
	I	II	III	IV	Remarks
ALGAE					
Acrosorium sp.		P			
Bossiella sp.	[P]	P		P,[P]	
Bryopsis corticucans		P			
Colpomenia sp.	P	P		P	
Corallina gracilis		P		P	
Corallina sp.	P	P		P	
Corallina vancouverensis	[P]				on Mytilus sp.
Cystoseira/Halidrys				A	
Dictyota flabellata	P			P	
Egregia laevigata		P		P	
Enteromorpha sp.	P	P	P	P	
Gelidium cartilagenum		P			
Gelidium coulteri		P			
Gelidium sp.	[P]			P,[P]	
Gigartina sp.	P	P		P	
Laurencia sp.	[P]			[P]	
Lithothamnion sp.	P			P	
Lithothrix aspergillum		P		P	
Macrocystis pyrifera				P	
Nemalion lubricum		P		P	
Pelvetia fastigiata				P	
Plocamium pacificum		P		P	
Ralfsia sp.	P	P	P	P	

TABLE 1. (Continued)

Scientific name	Transect and abundance *				Remarks
	I	II	III	IV	
Rhodoglossum parvum		P			
Rhodymenia sp.	P			P	
Sargassum sp.				P	
Ulva sp.	P	P	P	P	
ANTHOPHYTA (Flowering marine plants)					
Phyllospadix torreyi	P	P		P	
PROTOZOA					
Foraminifera (unident.)				P	
PORIFERA					
Porifera (unident.)					
CNIDARIA					
Actinaria (unident.)				P	
Aglaophenia sp.	P				
Anthopleura elegantissima	P	P		C	
Anthopleura xanthogrammica			A	C	
Campanularia sp.		P			
Hydrozoa (unident.)		P			
PLATYHELMINTHES					
Platyhelminthes (unident.)		P			
NEMATODA					
Nematoda (unident.)	P	P		[1]	
NEMERTEA					
Nemertea (unident.)	P,[30]	[[C]]			
POLYCHAETA					
Arabella iricolor	[3]	[[P]]			

TABLE 1. (Continued)

Scientific name	Transect and abundance *				Remarks
	I	II	III	IV	
Arabella semimaculata				[1]	
Arabella sp.				[1]	
Chone sp.		[[P]]			
Cirratulidae (unident.)				[4]	
Exogone lourei		[[P]]			
Lumbrineris sp.				[1]	
Naineris dendritica		[[P]]			
Nereidae (unident.)		[[P]]			
Nereis sp.	[12]			[2]	
Nothria sp.				[1]	
Odontosyllis phosphorea	[1]				
Orbiniidae (unident.)				[1]	
Phragmatopoma californica	[1]		P	P	
Polychaeta (unident.)	P	[[P]]		A	
Polyophthalmus pictus				[14]	
Serpulidae (unident.)				P	
Spirorbis sp.		[[P]]			
Tharyx sp.		[[P]]			
Typosyllis fasciata	[8]	[[A]]			
CRUSTACEA					
Balanus concavus pacificus	P	P		P	
Balanus glandula	P,[C]**	C			** on Mytilus sp.
Balanus tintinnabulum		P		P	
Cancer sp.				[1]	
Caprellidea (unident.)				A,[370]	

TABLE 1. (Continued)

Scientific name	Transect and abundance *				Remarks
	I	II	III	IV	
Chthalamus fissus	[S]**	C		C	** on Mytilus sp.
Chthalamus sp.	P	P	A	A	
Cumacea (unident.)		S		P,[2]	
Gammaridea (unident.)	P,[32]	C	C	A,[1600]	
Hyperiidea (unident.)	[S]				
Isopoda (unident.)	C,[117]	C	C	C,[91]	
Ligia occidentalis				P	
Loxorhynchus crispatus				P	
Ostracoda (unident.)		P		C	
Pachygrapsus crassipes	P	A	A	C	
Paguridae (unident.)				C,[6]	
Pagurus samulis				A	
Pagurus sp.				P	
Petrolisthes eriomerus				P	
Pollicipes polymerus	P,[309]	C			
Pugettia sp.				P	
Pycnogonida (unident.)	P,[2]	P		P	
Spirontocaris picta				P	
MOLLUSCA					
Acmaea mitra	[4]	P			
Acmaea rosacea				[1]	
Acmaea sp.		C	P		
Acmaeidae (unident.)	P			P	
Aplysia vaccaria				P	

TABLE 1. (Continued)

Scientific name	Transect and abundance *				Remarks
	I	II	III	IV	
Assimineidae (unident.)				P	
Barleeia sp.		C		C	
Caecum sp.		P		C,[628]	
Callistochiton crassicostatus	P			P	
Collisella asmi				P	
Collisella conus	[32]				
Collisella digitalis			P		
Collisella limatula		C	S		
Collisella ochracea				P	
Collisella scabra	P,[16]			P	
Collisella sp.			P		
Collisella strigatella	[1]				
Crepidula onyx				P	
Crepipatella lingulata				P	
Cyanoplax dentiens	[21]				
Fisurella volcano			S	P,[1]	
Gastropoda (unident.)	[2]	P	P	P,[6]	
Granulina margarinta				P	
Haminoea virescens				P,[1]	
Hiatella arctica				P	
Lacuna unifasciata				P	
Lepidozona californiensis				[3]	
Leptochiton rugatus				P	
Lithophaga plumula				P	

TABLE 1. (Continued)

Scientific name	Transect and abundance *				Remarks
	I	II	III	IV	
Littorina planaxis		P	C	P	
Littorina scutulata		C		P	
Littorina sp.	P		A	A	
Lottia gigantea	P,[4]	S	S	P	
Marginellidae (unident.)				P	
Magathura crenulata				P	
Mitrella aurantiaca				P	
Mopalia muscosa	P		C	P,[2]	
Mopalia sp.	P				
Mytilus californianus	C,[16]	C		P	
Mytilus edulis	C[22]	C	C	C	
Notoacmaea fenestrata	[6]	P	P	C	
Nuttalina fluxa	[1]				
Odostomia sp.				P	
Pelecypoda (unident.)				P	
Pholadidae (unident.				C	
Polyplacophora (unid.)	P[1]	P		P	
Spat (unident.)	[6]	P		[1]	
Stenoplax conspicua		P		P	
Tegula eiseni				P	
Tegula funebralis				C	
Tegula sp.				P	
Tricolia compta		P			
Tricolia sp.				P	
Truncatella californica				P	

TABLE 1. (Continued)

Scientific name	Transect and abundance *				Remarks
	I	II	III	IV	
Turbonilla kelseyi				P	
Vitrinellidae (unident.)				P	
ECHINODERMATA					
Echiuroidea (unident.)				[1]	
Ophiuroidea (unident.)				C,[4]	
Patiria miniata				P	
Strongylocentrotus purpuratus	P			[1]	

*Abundance symbols:

P = Present in the area but relative abundance not estimated.

S = Sparse - widely scattered throughout the area but nowhere numerous.

C = Common - unevenly present throughout the area and only occasionally numerous.

A = Abundant - numerous and evenly distributed throughout the area.

[] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.

[[]] = Double brackets around the abundance symbol indicate organisms incidentally picked up along study transect.

bordered by steep cliffs. The area otherwise resembles the previous description in physical characteristics. A total of seventeen different algae and the surf grass (Phyllospadix torreyi) was recorded at this station. This appears to be a slight decrease from the previous records of 22 algae and one species of surf grass; however, sea conditions precluded surveying the entire length of the intertidal transect. The invertebrate assemblage also reflects an apparent decrease, from 72 taxa in 1965 to 44 in the present study. Closer analysis shows that of the 72 invertebrates recorded in 1965, 30 were recorded solely from the quadrat collection, which was taken from a deeper tidal zone than was surveyed during the present study. Since no quadrat collection was taken during the present study, the deletion of those 30 animals from the previous list would make the numbers more comparable.

Transect III again reflects a modification of the intertidal environment from sandstone shelves in 1965 to a steep rock rip-rap face. The algal list consisted of only three relatively hardy algae during this survey, in contrast to ten recorded in 1965. The invertebrate assemblage included 18 taxa during this survey while 23 were recorded in 1965.

Transect IV, located near the southern tip of Point Loma, consists of a broad, gentle intertidal zone with many tidepools and a varied and lush biota. Twenty-one different algae were recorded, a moderate increase from the eleven recorded in 1965, while surf grass was present on both occasions. The invertebrate assemblage shows an increase from 38 taxa in 1965 to 85 in the present study. This increase is rather dramatic, and all taxa reflect the increase. The increase is most obvious in the microfauna, and is most probably the result of inclusion of small animals collected incidentally to clumps of algae, larger invertebrates, etc.

Subtidal

The subtidal portion of the transects was surveyed between June 1 and June 10, 1971, from the Department's research vessel Kelp Bass. The subtidal stations were located using the same methods utilized in the 1965 survey. Analysis of the data shows that this method of station location is not adequate, as we were not always able to duplicate the habitat types encountered during the original survey. As can be seen from a comparison of physical data in this and the 1965 reports, only nine of the 20 stations were relocated on the same general substrate type, a factor which precludes a total direct comparison of the two surveys. We can, however, make some general comparisons of a subjective nature in those instances where substrate differences occur.

20-foot stations

The 20-foot stations were surveyed on Transects I, II, and IV. Heavy surge, and a lack of visibility prevented any observations at the Transect III, 20-foot station. In general, these stations appear to show an increase in the variety of algae, with a shift to larger, brown, "kelp" algal forms. The invertebrate fauna also showed increases at the three transects surveyed.

The 20-foot station on Transect I was located on a sandy bottom containing large rock outcroppings, in contrast to the previous survey where the station was on low mudstone shelves. At the station, some giant kelp was encountered, while other "kelps" such as Egregia laevigata, Eisenia arborea, Pterygophora californica, and Laminaria farlowii were also present. Thirty-seven species of invertebrates and five species of fish were also reported at this station (Table 2).

At Transect II, the 20-foot station again was located on a sand bottom with large rock outcroppings, in contrast to the low sandstone shelves reported previously. This station reflects none of the effects from the

TABLE 2. Plants and Animals Recorded at 20-foot Depth Stations, Point Loma, June 1-10, 1971

Scientific name	Transect and abundance *			
	I	II	III	IV
ALGAE				
Bossiella sp.	(C)	P		(A)
Callithamnion sp.				(P)
Codium sp.				(A)
Corallina sp.		P		
Cystoseira/Halidrys	(21)			(36)
Dictyopteris zonarioides		(10)		
Dictyota flabellata	(2)			
Egregia laevigata	(5)	(117)		P
Eisenia arborea	(3)			
Gelidium sp.		P	A	
Laminaria farlowii	(2)			(13)
Lithothamnion sp.	(C)			(A)
Macrocystis pyrifera	(2)			
Peyssonelia sp.		P		
Plocamium sp.	(P)			
Pterygophora californica	(2)			(3)
Ptilota sp.			P	
Rhodophyta (unident.)	(C)			
Rhodymenia sp.	(P)	P,(P)		
Sargassum agardhianum			A	
ANTHOPHYTA (Flowering marine plants)				
Phyllospadix torreyi	(3)	(P)		(A)

TABLE 2. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
PROTOZOA				
Foraminifera		[[P]]		
PORIFERA				
Porifera (unident.)	(P)			(P)
CNIDARIA				
Anthopleura sp.	1,(1)			
Epiactis prolifera	(1)			
Tealia sp.	(1)			
NEMATODA				
Nematoda (unident.)		[[P]]		
NEMERTEA				
Nemertea (unident.)	[[P]]			
POLYCHAETA				
Chaetopteridae (unident.)				[1]
Chrysopetalidae (unident.)	[[P]]			
Dasybranchus sp.	[[P]]			
Eunicidae (unident.)				[[P]]
Eupomatus gracilis	[[P]]	[[P]]		[[P]]
Glycera sp.				[1]
Lumbrineris sp.				[[P]]
Nereidae (unident.)		[[P]]		[2]
Paleanotus bellis		[[P]]		
Phragmatopoma californica	1			
Phyllodocidae (unident)	[[P]]	[[P]]		[[P]]
Polychaeta (unident.)	[[P]]			
Polydora sp.		[[P]]		[[P]]

TABLE 2. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Sabellaria cementarium		[1]		
Sabellidae (unident.)		[[P]]		[[P]]
Syllidae (unident.)	[[P]]	[1]		[4]
Typosyllis sp.		[[P]]		
SIPUNCULIDA				
Sipunculida (unident.)				[[P]]
CRUSTACEA				
Caprellidea (unident.)	[[A]]	[[A]]		[4]
Cryptolithodes sitchensis				(1)
Flabellifera (unident.)	[[P]]			
Gammaridea (unident.)	[[A]] ((1))	[[A]]		[18]
Isopoda (unident.)		[[P]]		
Paguridae (unident.)		[1]		
Panulirus interruptus		2		
Pentidotea aculeata	[[P]]			
Pycnogonida (unident.)	[[P]]			
MOLLUSCA				
Acmaeidae (unident.)				[1]
Adula diegensis		[[P]]		
Alvinia sp.		[[P]]		
Barleeia sp.	[[P]]			[1]
Caecum sp.				[[P]]
Conus californicus	(1)	[[P]]		
Crepidula sp.	[[P]]			(P)

TABLE 2. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Dentalium sp.	[[P]]			[8]
Fissurelidae (unident.)				[1]
Gastropoda (unident.)	[[P]]			
Hiatella arctica		[[P]]		[[P]]
Lithophaga plumula				[[P]]
Lucinidae (unident.)		[[P]]		
Mitra idae				[[P]]
Mitra sp.				(1)
Mitrella aurantiaca				[1]
Mitrella carinata	[[P]]			
Mitrella gausapata	[[C]]			
Mitrella tuberosa	[[P]]			
Mytilidae (unident.)				[1]
Naticidae (unident.)	[[A]]			
Netastoma sp.		[[P]]		
Norrissia norrissi	(1)			
Notoacmaea sp.		[[P]]		
Olivella biplicata		[2]		
Olivella sp.		[1]		
Pelecypoda (unident.)		[[P]]		
Penitella penita		[[P]]		
Pholadidae (unident.)		[[P]]		(17)
Polyplacophora (unident.)	[[P]]	[[P]]		[1]
Rissoella sp.	[[P]]			

TABLE 2. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Serpulorbis sp.	1			
Tegula sp.		[[P]]		(1)
Tricolia sp.	[[P]]	[[P]]		[6]
ECHINODERMATA				
Astrometis sertulifera	(2)			
Ophiuroidea (unident.)				[1]
Pisaster sp.	1			
Scelasterias heteropaes	[[P]]			
Strongylocentrotus purpuratus	(1),[[P]]			
ASCIDIACEA				
Ascidiacea (unident.)	(1)			
Styela montereyensis	(1)			
PISCES				
Embiotoca jacksoni	5	P		P
Gibbonsia sp.	1			
Girella nigricans		P		
Halichoeres semicinctus	1			
Hypsurus caryi		P		
Myliobatis californica	1			
Paralabrax clathratus	2	P		P
Paralabrax nebulifer		P		
Pimelometopon pulchrum		P		
Scorpaena guttata		P		

TABLE 2. (Continued)

* Abundance Symbols

P = Present in the area but relative abundance not estimated.

S = Sparse - widely scattered throughout the area but nowhere numerous.

C = Common - unevenly present throughout the area and only occasionally numerous.

A = Abundant - numerous and evenly distributed throughout the area.

[] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.

() = Parentheses around the abundance symbol indicate occurrence within the arc study area.

[[]] = Double brackets around the abundance symbol indicate occurrence in diver pick-up within the arc study area.

(()) = Double parentheses around the abundance symbol indicate occurrence in the polychaete sample.

changes made to the intertidal zone of this transect. Station data show an increase in invertebrate populations; however, most of the invertebrates were small species from quadrat collections, or collected incidentally by the divers. The most obvious plants in the area were the feather-boa kelp and surf grass. There were six other species of algae present in the arc. No green abalone (Haliotis fulgens), were noted in the area whereas ten were observed in 1965, 2 of which were within the arc.

At Transect IV, the 20-foot station was located on a flat mudstone bottom with coarse sand covering it in spots. This substrate type is generally comparable to that found in the 1965 survey. The algal species diversity is generally comparable to both that found previously and to the intertidal portion of the transect. The invertebrate fauna shows an increase in diversity comparable to the increase present in the intertidal zone; however, as with Transect II the majority of the animals recorded were small organisms collected by the divers along with masses of algae or larger invertebrates.

40-foot stations

Stations were surveyed at 40-foot depths along each of the four transects. Substrate differences compared to the 1965 survey were apparent at two of the transects. The increase in brown algae noted in 20-foot depths was also noted at the 40-foot stations.

The 40-foot station at Transect I was entirely on a sandy bottom as compared to the heavily bored, low mudstone shelves surveyed in 1965. Species diversity including extralimital sampling was similar, however, the red algae reported in 1965 appear to have been replaced by the larger brown algae, Laminaria farlowii and Pterygophora californica (Table 3). Polychaete worms (Diopatra sp.), sea pansies (Renilla kollikeri), and sea stars (Astropecten verrilli) were the most common animals seen in the arc area, and are typically found on shallow sand bottoms in southern California.

TABLE 3. Plants and Animals Recorded at 40-foot Depth Stations, Point Loma, June 1-10, 1971

Scientific name	Transect and abundance *			
	I	II	III	IV
ALGAE				
Bossiella sp.	1	(P)	(A)	(P)
Corallina sp.			(A)	
Cystoseira/Halidrys			(42)	(P)
Laminaria farlowii	1		(67)	
Lithothamnion sp.		[[P]]	(P)	
Macrocystis pyrifera		(P)		(P)
Peyssonelia sp.			(P)	
Pterygophora californica	1	(3)	(8)	(A)
Rhodophyta (unident.)				(P)
Rhodymenia sp.			(C)	
PROTOZOA				
Foraminifera				[A]
PORIFERA				
Leuconia sp.				(1)
Porifera (unident.)			(C),[2]	(P)
Rhabdodermella nuttingi				(C)
Tethya aurantia		(1)		
CNIDARIA				
Actinaria (unident.)			(1)	(P),[1]
Aglaophenia struthionides	((P))			
Anthopleura sp.		(P)		(1)
Astrangia lajollaensis		(P),[2]		
Balanophyllia elegans		(9)		

TABLE 3. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Cerianthidae (unident.)		(1)		
Epiactis prolifera				(1)
Renilla kollikeri	(3)			
Tealia sp.	1			
NEMATODA				
Nematoda (unident.)		[2]	[11]	[[P]]
NEMERTEA				
Nemertea (unident.)		[2]		
POLYCHAETA				
Arabella iricolor		[1]		
Boccardia sp.				[3]
Chaetopteridae (unident.)				[[P]]
Diopatra ornata	(4)			
Diopatra sp.	(30),[16]	(32)		(S)
Exogone lourei			[2]	
Glycera sp.	((3))			
Halosydna johnsoni		[[P]]		
Maldanidae (unident.)				[1]
Nereidae (unident.)				[2]
Nothria sp.	((1))			
Odontosyllis phosphorea				[1]
Onuphidae (unident.)			[1]	
Pectinaria sp.	((2))			
Phyllodocidae (unident.)		[[P]]		[[P]]
Pilargidae (unident.)			[1]	

TABLE 3. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Polydora sp.			[2]	
Polynoidae (unident.)		[1]		[1]
Sabellaria cementarium		[1]		[[P]]
Sabellaria sp.				[1]
Sabellidae (unident.)			[1]	[[P]]
Serpulidae (unident.)		[2]		
Spiophanes missionensis	((1))			
Spirorbis sp.		[2]	[[P]]	
Syllidae (unident.)		[1]	[6]	[14]
Terebellidae (unident.)			[[P]]	
Thalenessa spinosa	((1))			
Tharyx multifilis	((1))			
CRUSTACEA				
Cancer jordani			[1]	
Caprellidea (unident.)		[1]	[7]	[5]
Cumacea (unident.)	((2))			
Gammaridea (unident.)		[153]	[145]	[55]
Hermit Crab (unident.)	((8))			
Isopoda (unident.)	(1)	[8]	[40]	[54]
Loxorhynchus crispatus				[[P]]
Loxorhynchus sp.				[1]
Paguridae (unident.)		(1)		[2]
Panulirus interruptus		P		
Pycnogonida (unident.)				[2]

TABLE 3. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
MOLLUSCA				
Acanthochitona avicula		[2]		
Acmaeidae (unident.)			[1]	[8]
Acteocina sp.				[1]
Acteon punctocoelatus	((1))			
Anisodoris nobilis	1			
Astraea gibberosa			(1)	
Astraea undosa	1			
Barleeia sp.			[1]	[40]
Bittium sp.			[1]	
Cadlina limbaughi		P		
Caecum sp.			[[P]]	[17]
Conus californicus			[1]	(8)
Crassispira semiimflata				[11]
Crepidula aculeata		[8]		
Crepidula norrisiarum		[1]		
Crepidula sp.			[[P]]	[[P]]
Cyanoplax sp.		[1]		
Cypraea spadicea				(1)
Dendrodoris fulva		(3)		(5)
Diaulula sandiegensis				(1)
Gastropoda (unident.)			[10]	[4],(1)
Hiatella arctica				[[P]]
Homalopoma sp.		[5]		
Kelletia kelleti	1	(11)	(1)	(12)

TABLE 3. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Kelletia kelleti eggs		(P)		
Lepidozona californiensis		[1]		
Lithophaga plumula				[[P]]
Maxwellia santarosana		(1)		
Megathura crenulata	1			
Mitra idae		(1),[1]		(7)
Mitra sp.		[[P]]		
Mitrella aurantiaca			[[P]]	
Nassarius perpinguis	(1)			
Ophiodermella ophioderma	(1)			
Pelecypoda (unident.)				[4]
Pitar newcombianus				[1]
Polinices lewisii	(1)			
Polinices sp.	[[P]]			
Polyplacophora (unident.)	((1))			
Siphonariidae (unident.)		[[P]]		
Tagelus sp.	((1))			
Tectibranchia (unident.)				[[P]]
Tellina sp.	((1))			
Turbinidae (unident.)				[1]
Tricolia sp.			[6]	[10]
Tylodina sp.		[4]		
Williamina peltoides		[1]		

TABLE 3. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
ECHINODERMATA				
Astrometis sertulifera		(3)		
Astropecten verrilli	(2)			
Cucumaria sp.				(1)
Dermasterias imbricatus		P		
Henricia leviuscula			(1),[1]	
Holothuroidea (unident.)			[[p]]	[2]
Lytechinus anamesus		(1)		
Ophiuroidea (unident.)	((1))	[1]	[1]	[3]
Parastichopus sp.		(2)		
Patiria miniata				(1)
Pisaster giganteus	1	(3)		(2)
Strongylocentrotus franciscanus	1	(9)		
Strongylocentrotus purpuratus		(132)	(A)	
Strongylocentrotus sp.			[1]	
ASCIDIACEA				
Ascidiacea (unident.)		[[P]]		(P),[1]
Ascidia ceratodes				[[P]]
Chelyosoma macleayanum				[[P]]
Clavelina huntsmani				(P)
Styela montereyensis		(P)	(5)	(6)
PISCES				
Cottidae (unident.)			P	
Embiotoca jacksoni		C	P	P
Halichoeres semicinctus			P	

TABLE 3. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Hypsurus caryi		C		
Oxyjulis californica			P	
Oxylebius pictus		C		
Paralabrax clathratus	1	A	P	P
Paralabrax nebulifer	1	A		P
Phanerodon furcatus		C		
Pimelometopon pulchrum		C		
Pleronichthys coenosus		P		
Rhacochilus vacca		C		
Scorpaena guttata		(1)		
Sebastes dalli				(P)

Abundance Symbols *

P = Present in the area but relative abundance not estimated.
S = Sparse - widely scattered throughout the area but nowhere numerous.
C = Common - unevenly present throughout the area and only occasionally numerous.
A = Abundant - numerous and evenly distributed throughout the area.
[] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.
() = Parentheses around the abundance symbol indicate occurrence within the arc study area.
[[]] = Double brackets around the abundance symbol indicate occurrence in diver pick-up within the arc study area.
(()) = Double parentheses around the abundance symbol indicate occurrence in the polychaete sample.

At Transect II, the 40-foot station was immediately adjacent to a bed of Macrocystis, and while the bottom would still be considered urchin dominated as noted in 1965, there were more large invertebrate species than reported previously. Macrocystis holdfasts with the stipes grazed away were observed in the arc area indicating that the urchins may have moved into the area relatively recently. This area, like Transect I, was a mixed sand and rock bottom. Polychaete worms (Diopatra sp.) dominated the sand areas while urchins were dominant on the rocks. We did not record any of the yellowfin fringeheads (Neoclinus stephensae) that were observed in 1965, but the typically aggregated distribution of this fish would make them easy to miss in a survey of this kind.

At Transect III the Macrocystis bed recorded at the 40-foot station in 1965 was not encountered. In place of Macrocystis we found lush growths of Pterygophora, Laminaria and Cystoseira/Halidrys over a heavy growth of coralline algae and Rhodymenia sp. It is uncommon to find these lower growing brown algae very abundant under a dense canopy of Macrocystis and quite often their presence inhibits the settling of Macrocystis sporophytes. Although the same low relief rock was found, the station was probably not in this exact location in 1965; therefore, our data do not necessarily indicate a change has occurred. The most obvious animals in the arc area were purple urchins (Strongylocentrotus purpuratus), solitary ascidians (Styela montereyensis), and several encrusting sponges.

The 40-foot station at Transect IV was on a flat mudstone bottom with sand and shelly debris instead of the mudstone shelves with numerous cobbles and boulders reported at this station in 1965. The plants and animals found during this survey were very similar to the 1965 study except that we did not record any urchins which were noted as common in 1965. There was a low canopy of Pterygophora with some Macrocystis in the area.

The most obvious animals noted were large whelks (Kelletia kelletii), starfish, (Patiria and Pisaster) and solitary ascidians (Styela montereyensis).

60-foot stations

Station areas surveyed at 60-foot depths were comparable to those done in 1965 in that all were on rocky or at least partially rocky substrate, and either in or near beds of giant kelp.

Fewer animal species were recorded during this survey at Transect I, 60 feet, than reported in 1965 (Table 4). This decrease can be attributed to the loose sand covering about one half of the arc. A canopy of low brown algae was present, including Pterygophora, Cystoseira/Halidrys and Laminaria. Tunicates were abundant, with both Styela montereyensis and Boltenia villosa present.

At Transect II, the station was located on rock substrate, in contrast to the mixed sandstone-sand bottom present during the 1965 survey. The algal cover again reflected an increase in low brown "kelps" along with a general increase in algae. Invertebrates were generally comparable to the 1965 report with all groups well represented in a very diverse faunal assemblage.

On Transect III, the 60-foot station was located on flat sandstone with sand patches, similar to that found in 1965. Algal cover was sparse but invertebrates were well represented with echinoderms, molluscs and stony corals most apparent. The two surveys were comparable in both the fauna and flora present at this station.

In 1965 the 60-foot station at Transect IV was located on a mixed bottom of coarse sand, cobbles and boulders over a sandstone base and on sandstone shelves during this survey. The floral assemblage was dominated by coralline algae, while the invertebrate fauna included bryozoans, stony corals, and bat stars, Patiria miniata.

TABLE 4. Plants and Animals Recorded at 60-foot Depth Stations, Point Loma, June 1-10, 1972

Scientific name	Transect and abundance *			
	I	II	III	IV
ALGAE				
Agarum fimbriatum		(14)	(4)	(P)
Bossiella sp.	(P)	(A)	(P)	(P)
Codium sp.	(1)	(S)		
Corallina sp.		(A)		
Cystoseira/Halidrys	P,(12)	(3)	(3)	(C)
Laminaria farlowii	P,(34)	(1)	(4)	(P)
Lithothamnion sp.		(P)		(P)
Macrocystis pyrifera		(1)	P	P
Pelagophycus porra		(1)	P,(1)	P,(5)
Peyssonelia sp.		(P)		
Plocamium sp.			(1)	
Pterygophora californica	P,(20)			(1)
Rhodophyta (unident.)	(C)	(P)	(P)	(P)
Rhodymenia sp.		(P)		(P)
PROTOZOA				
Foraminifera		[3]		
PORIFERA				
Porifera (unident.)	1	(P)	(1)	(C)
Rhabdodermella nuttingi	[[P]]	[[P]]		(5)
Tethya aurantia		(1)	(4)	(9)
CNIDARIA				
Aglaophenia sp.		(P)		
Actinaria (unident.)		(C),[1]		

TABLE 4. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Aglaophenia struthionides	(P),[P]			
Astrangia lajollaensis		(P),P		[[P]]
Balanophyllia elegans		(A)	(P)	(P)
Campanularia sp.		P		
Cerianthidae (unident.)			(2)	
Coryanactis californica	(2)	(P)	(P)	
Epiactis prolifera	(1)			
Muricea californica	1,(1)			
Paracyathus stearnsii		(P)	(3)	(P)
Sertularella turgida	[P]			
Tealia lofotensis		(1)		
NEMATODA				
Nematoda (unident.)		[13]		[3]
NEMERTEA				
Nemertea (unident.)	[[P]]		[[P]]	
POLYCHAETA				
Diopatra sp.	1,(1)		(C)	
Eudistylia polymorpha		[[P]]		
Eunice antennata				[[P]]
Eunice sp.		[[P]]		
Eusyllis transecta		[3]		
Exogone lourei		[6]		
Exogone sp.				[2]
Flabelliderma commensalis		[1]		
Halosydna sp.		[1]		

TABLE 4. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Hesionidae (unident.)			[1]	
Laonice cirrata			[1]	
Lepidonotus sp.		[1]		
Lumbrineris sp.		[[P]]		
Naineris dendritica		[[P]]		
Nereidae (unident.)		[[P]]		
Nereis sp.		[8]		
Odontosyllis parva		[1]		[1]
Odontosyllis phosphorea	[1]	[3]		
Ophiodromus pugettensis		[[P]]		
Paleanotus bellis			[1]	
Paleanotus sp.	[[P]]			
Palola paloloides		[[P]]		
Peisidice aspera	[4]		[2]	[4]
Pherusa sp.	[[P]]			
Phyllodocidae (unident.)		[7]	[5]	
Pista sp.		[1], P		
Polychaeta (unident.)	[[P]]	[[P]]	[1]	
Polydora sp.		[2]	[1]	
Polynoidae (unident.)	[[P]]	[1]		
Sabellaria cementarium	[[P]]	[[P]]	[[P]]	
Sabellidae (unident.)	[[P]]	[3]		
Salmacina tribranchiata				(1)
Serpula vermicularis		[[P]]		
Spirobranchus spinosus		[[P]]		

TABLE 4. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Spirorbis borealis				[6]
Spirorbis eximius		[[P]]		
Spirorbis sp.		[14]	[7]	
Syllidae (unident.)	[1]	[1],P	[3]	[[P]]
Syllis gracilis	[[P]]	[1]		
Terebella californica	[[P]]			
Terebellidae (unident.)		[[P]]		
Typosyllis fasciata				[1]
Typosyllis sp.		[10]		
CRUSTACEA				
Balanus sp.	[1]			
Cancer jordani		[[P]]		
Caprellidea (unident.)	[5]	[49],P	[[P]]	[4]
Cumacea (unident.)	[1]	[[P]]		
Decapoda (unident.)	[1]			
Gammaridea (unident.)	[44]	[1040]	[20]	[47]
Isopoda (unident.)	[3]	[25]		[2]
Loxorhynchus crispatus	[1]			
Natantia (unident.)		[[P]]		
Pachycheles rudis		[[P]]		
Paguridae (unident.)			[1]	
Pycnogonida (unident.)		[[P]]		[2]
Shrimp (unident.)				[1]
MOLLUSCA				
Acmaeidae (unident.)				[2]
Acteocina sp.			[1]	

TABLE 4. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Acteon punctocoelatus			(2)	(2)
Anisodoris nobilis		(3)		
Astraea gibberosa			(1)	
Astraea undosa				P
Astraea sp.	(3)			
Barleeia sp.				[1]
Cadlina limbaughi		(2)		
Caecum sp.		[[P]]	[4]	
Calliostoma sp.		[[P]]		
Callistochiton crassicostatus		[[P]]		
Chama pellucidae		[[P]]		
Conus californicus			(3)	(1)
Crassispira semiinflata			(1)	P
Crepidula sp.	[[P]]	[1]	[1]	[9]
Cylichna sp.		[[P]]		
Cypraea spadicea		(1)		
Dendrodoris fulva		(1)	(1)	(1)
Dendropoma sp.		[1]		
Dentalium sp.	[1]			
Diaulula sandiegensis		(1)		
Donax sp.		[[C]]		
Epitonium tinctum		[[P]]		
Gastropoda (unident.)			[7]	
Hiatella arctica		[17]		[2]
Hinnites multirugosus		(7)		

TABLE 4. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Hipponix antiquatus		[[P]]		
Homalopoma sp.		[4]		
Kelletia kelleti	1	(5)	(14),[1]	(1)
Kelletia kelleti "eggs"	(P)			
Lithophaga plumula	[[P]]			
Lucinidae (unident.)	[[P]]	[6]		
Macoma sp.				[[P]]
Maxwellia santarosana		[[P]]		
Megatebennus bimaculatus		[[P]]		
Mitra idae		(1)	(2)	
Mitra sp.	(1)			
Mopalia porifera		[[P]]		
Mytilidae (unident.)				[1]
Nassarina penicillata		[[P]]		
Naticidae (unident.)	[[P]]			
Notoacmaea paleacea		[[P]]		
Nudibranchia (unident.)			[[P]]	(3)
Oceanebra foveolata		[[P]]		
Octopus sp.	[[P]]			
Opisthobranchia (unident.)	[1]	[[P]]		
Pectinidae (unident.)				[1]
Pelecypoda (unident.)	[4]			
Penitella penita		[[P]]		
Pholadidae (unident.)		(P)		P
Pitar newcombianus	[9]	[[P]]	[3]	[5]

TABLE 4. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Pododesmus cepio		(1)		
Polyplacophora (unident.)	[[P]]		[[P]]	[2]
Trivia solandri		[[P]]		
Tricolia sp.	[1]	[3]		[[P]]
BRYOZOA				
Antropora tincta		[[P]]		
Bryozoa (unident.)	[[P]]	(S),[12]		(1)
Crisiidae (unident.)		[[C]]		
Diaperoecia californica		(A), [[P]]		(1)
Lichenopora sp.		(1)		
Phidolopora pacifica		(P)		(2)
BRACHIOPODA				
Terebratalia transversa		[[P]]		
ECHINODERMATA				
Asteroidea (unident.)		(P)	(1)	
Dermasterias imbricatus			(1)	(1)
Henricia leviuscula	(1)	[1]		
Linckia columbiae		(2)		(1)
Lytechinus anamesus			(1)	P
Ophiuroidea (unident.)	[1]	[1]	[9]	[8]
Orthasterias sp.			(1)	
Parastichopus sp.	1	(7)		
Patiria miniata	(1)	(4)	(19)	(22)
Pisaster brevispinnus	1		[[P]]	
Pisaster giganteus	1	(2)	[[P]]	(1)

TABLE 4. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Strongylocentrotus franciscanus		(51)		P,[1]
Strongylocentrotus purpuratus		(33),[2]	P	P
ASCIDIACEA				
Ascidiacea (unident.)	[1]	[1]	1	
Ascidia compositae		[[P]]		
Boltenia villosa	(P)	(P)		[[P]]
Clavelina huntsmani		(P)		
Styela montereyensis	(31)	(2)	(5)	(2)
PISCES				
Brachyistius frenatus		P		
Caulolatilis princiceps	1			
Chromis punctipinnis		100+		
Coryphopterus nicholsi	(1)			
Embiotoca jacksoni	1	15	1	P
Halichores semicinctus		100+		
Hypsurus caryi		10		P
Neoclinus stephensae	1			
Orthonopias triacis			(1)	
Oxyjulis californica		P	P	200
Oxylebius pictus		(P)		P
Paralabrax clathratus	5	5	P	P
Pimelometopon pulchrum	3	5		4
Rathbunella sp.		(C)		
Rhacochilus vacca	1		1	P
Sebastes atrovirens	(1)	5		

TABLE 4. (Continued)

Scientific name	Transect and abundance *			
	I	II	III	IV
Sebastes auriculatus	1			
Sebastes carnatus	1	7		
Sebastes dalli				P
Sebastes sp. (juv.)				P
Sebastes serranoides	1			P
Sebastes serriceps	1,(1)	1		

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* Abundance symbols:

P = Present in the area but relative abundance not estimated.

S = Sparse - widely scattered throughout the area but nowhere numerous.

C = Common - unevenly present throughout the area and only occasionally numerous.

A = Abundant - numerous and evenly distributed throughout the area.

[] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.

() = Parentheses around the abundance symbol indicate occurrence within the arc study area.

[[]] = Double brackets around the abundance symbol indicate occurrence in diver pick-up within the arc study area.

80-foot stations

The arc area at the 80-foot station on Transect I consisted of low relief rock in 1965 and on rock with sand intrusions in 1971. The survey of the area, including extralimital observations, revealed a low canopy of brown algae (Cystoseira and Laminaria). The dominant animals found were molluscs and the bat star (Patiria miniata) (Table 5). Our arc and quadrat samples revealed a greater species diversity than in 1965, but the arc area of the earlier survey was reportedly not typical of the general area and a more diverse biota was found outside the arc.

Our findings at Transect II, 80 feet reflect a slight increase in species diversity within the 15 m^2 arc area, but a decrease in diversity when extralimital sampling is included. The arc area was flat rock with scattered car sized boulders, while in 1965 it consisted of rock ledges with coarse sand intrusions. The most obvious organisms in the arc area were large brown algae (Laminaria farlowii), rock scallops (Hinnites multirugosus), sponges, the sea stars (Patiria miniata and Henricia laeviscula) and several species of bryozoans. The biological description of this area in 1965 is close to what we found in 1971 except that a larger extralimital area was covered in 1965.

Large quantities of loose sediment covered the pavement-like rock at Transect III, compared to the flat sandstone substrate encountered in the 1965 survey. The most obvious organisms in the arc were brown algae (Agarum fimbriatum), coralline algae, bat stars (Patiria miniata) and the large whelk (Kelletia kelletii). The species diversity was lower than that recorded in 1965 and no Macrocystis or Pelagophycus was recorded.

The most abundant animals recorded on the mixed sand and rock substrate at Transect IV, 80 feet were bat stars (Patiria miniata), stony corals, polychaete worms and various molluscs. The substrate type and biota described in the two surveys are very similar with many of the same species

TABLE 5. Plants and Animals Recorded at 80-foot Depth Stations, Point Loma, June 1-10, 1972

Scientific name	Transect and abundance*			
	I	II	III	IV
ALGAE				
Agarum fimbriatum	(1)		(8)	
Bossiella californica		(P)		
Bossiella orbigiana		P		
Bossiella sp.	(C),[1]	(1)	(C)	(P)
Cystoseira/Halidrys	C,(12)			(2)
Gigartina sp.				(1)
Laminaria farlowii	C,(10)	(12)		
Lithothamnion sp.	(P),[P]	(A)	(P)	(A),[C]
Lithothrix aspergillum		P		
Pelagophycus porra		P		(1)
Peyssonelia sp.	[1]		(P)	[P]
Rhodophyta (unident.)	(C),[2]			(P)
Rhodymenia sp.			(P)	
PROTOZOA				
Foraminifera			[4]	
PORIFERA				
Porifera (unident.)	(2)	(16)	(8),[1]	(P)
Rhabdodermella nuttingi				[4]
Spheciospongia confoederata				(1)
Tethya aurantia	(4)		(C)	(1)
CNIDARIA				
Aglaophenia sp.	P		P	
Aglaophenia struthionides	(P)	[1]		

TABLE 5. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Astrangia lajollaensis	[[P]]		(P),[14]	[2]
Balanophyllia elegans	(1)	[4]		(C),[P]
Cornularia sp.			(1)	
Coryanactis californica	1	(3)		[P]
Hydrozoa (unident.)		(2)		
Paracyathus stearnsii		(5)	(P)	[[P]]
Stolenifera (unident.)		[P]		
NEMATODA				
Nematoda (unident.)			[10]	
NEMERTEA				
Nemertea (unident.)	[[P]]		[[P]]	[2]
POLYCHAETA				
Ampharetidae (unident.)			[[P]]	
Boccardia sp.	[[P]]			
Chaetopteridae (unident.)				[[P]]
Chloeia pinnata			[2]	
Chone sp.	[[P]]			
Diopatra sp.	(2)			(A)
Eudistylia vancouveri				[2]
Euphrosine aurantiaca				[1]
Hesionidae (unident.)				[[P]]
Lepidonotus sp.				[3]
Lumbrineris sp.			[[P]]	
Nereidae (unident.)			[5]	[2]
Oncoscolex pacificus			[[P]]	

TABLE 5. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Opheliidae (unident.)				[2]
Palola paloloides			[2]	
Peisidice aspera			[4]	
Pherusa inflata				[[P]]
Phyllodocidae (unident.)			[5]	[[P]]
Polychaeta (unident.)			[1]	
Polynoidae (unident.)			[1]	[1]
Sabellaria cementarium		[1]		
Sabellidae (unident.)			[1]	
Salmacina tribranchiata		(1)		
Serpula vermicularis			[4]	[1]
Serpulidae (unident.)			[2]	
Spiophanes bombyx	[[P]]			
Spirorbis borealis		[C]		[[P]]
Spirorbis sp.	[[P]]	[C]		
Syllidae (unident.)	[[P]]		[13]	
Syllis gracilis		[[P]]		
CRUSTACEA				
Balanus sp.		[1]		
Caprellidea (unident.)	[[P]]		[3]	[2]
Gammaridea (unident.)	[[P]]	[[P]]	[16]	[20]
Isopoda (unident.)	[[2]]		[2]	[1]
Loxorhynchus crispatus				[1]
Paguridae (unident.)			[1]	[[P]]
Pycnogonida (unident.)		[[P]]		[[P]]

TABLE 5. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Shrimp (unident.)				[1]
MOLLUSCA				
Acmaeidae (unident.)			[1]	
Acteocina sp.				[[P]]
Anisodoris nobilis				(1)
Astraea gibberosa			(1),[1]	
Astraea undosa	(1)			
Astraea sp.		(1)		
Cadlina limbaughi				(2)
Cadlina luteomarginata		(1)		(2)
Caecum sp.			[[P]]	[[P]]
Cardiidae (unident.)			[5]	
Chaceia ovoidea			(1)	
Conus californicus	1,(2)	(2)	(1),[1]	
Crassispira semiinflata	(1)	(1)		(1)
Crepidula sp.	[[P]]		[8]	
Cystiscus sp.				[[P]]
Dendrodoris fulva	1	(1)		(1)
Flabellinopsis iodinea	(1)	(2)	(1)	
Hinnites multirugosus		(6)	(1)	
Kelletia kelleti	(1)		(5)	(1)
Kelletia kelleti "eggs"				(P)
Kellia laperousi			[[P]]	
Lucinidae (unident.)		[[P]]		
Maxwellia santarosana	[[P]]			

TABLE 5. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Maxwellia sp.	(1)			
Mytilidae (unident.)			[2]	
Nudibranchia (unident.)		[[P]]		[[P]]
Opisthobranchia (unident.)			(1)	
Pectinidae (unident.)			[1]	[1]
Pelecypoda (unident.)	[[P]]		[26]	[3]
Pitar newcombianus				[[P]]
Polyplacophora (unident.)			[2]	[4]
Tectibranchia (unident.)				[1]
Tricolia sp.				[[P]]
Ventricoloria fordi				[[P]]
BRYOZOA				
Antropora tincta			[1]	
Bryozoa (unident.)		(3)	[1]	[P]
Cheilostomata (unident.)		[1]		
Diaperoecia californica		(3)	(P)	(2)
Phidolopora pacifica		(1)		
BRACHIOPODA				
Brachiopoda (unident.)				[4]
ECHINODERMATA				
Henricia leviuscula		(3)	[[P]]	[1]
Holothuroidea (unident.)			[1]	[[P]]
Linckia columbiae		(2)	(1)	
Lytechinus anamesus		(1)		
Ophiuroidea (unident.)	[[P]]	[[P]]	[3]	[10]

TABLE 5. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Parastichopus parvimensis		(1)		
Parastichopus sp.			(1)	
Patiria miniata	(11)	(10)	(4)	(11)
Pisaster giganteus		(2)		
Strongylocentrotus purpuratus	[1]		(1)	
ASCIDIACEA				
Ascidiacea (unident.)		[1]	[5]	[P]
Boltenia villosa	(C)			
Clavelina huntsmani		(1)	(1)	
Styela montereyensis	(2)	(2)		
PISCES				
Artedius corallinus		(1)	(1)	
Caulolatilis princiceps	1			
Coryphopterus nicholsi	(1)		P,(2)	P,(2)
Embiotoca jacksoni		P,(1)		P
Halichoeres semicinctus		P		
Hypsurus caryi				P
Orthonopias triacis		(3)		
Oxylebius pictus			P	P
Paralabrax clathratus	2	P		
Phanerodon furcatus			P	
Pimelometopon pulchrum		P	P	
Rathbunella sp.		(1)	(4)	6,(3)
Rhacochilus toxotes			P	

TABLE 5. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Rhacochilus vacca			100	
Scorpaenichthys marmoratus		P	1	
Sebastes atrovirens	2			
Sebastes auriculatus	1,(1)			
Sebastes carnatus		P		(P)
Sebastes caurinus			P	
Sebastes dalli	(1)		P,(2)	P,(P)
Sebastes miniatus	2			
Sebastes mystinus	1			
Sebastes serranoides	1	P	1	P
Sebastes serriceps			1	
Sebastes umbrosus			1	(P)

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* Abundance Symbols:

P = Present in the area but relative abundance not estimated.

S = Sparse - widely scattered throughout the area but nowhere numerous.

C = Common - unevenly present throughout the area and only occasionally numerous.

A = Abundant - numerous and evenly distributed throughout the area.

[] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.

() = Parentheses around the abundance symbol indicate occurrence within the arc study area.

[[]] = Double brackets around the abundance symbol indicate occurrence in diver pick-up within the arc study area.

and groups recorded. However, a few of the largest organisms recorded in 1965, Lophogorgia chilensis, Strongylocentrotus franciscanis, red abalone (Haliotis rufescens) and sheephead (Pimelometopon pulchrum), were not noted during this survey.

100-foot stations

The flat pavement-like rock and sand and shell debris found at Transect I, 100 feet, was similar to that described in 1965. Low growing red algae recorded as common in 1965 were again found to be common. The brown algae, Cystoseira/Halidrys and Agarum fimbriatum, were also common in the arc area (Table 6). Echinoderms and molluscs were the dominant animal groups represented in the area which included organisms associated with both sandy and rocky habitats.

The gorgonian coral, Lophogorgia chilensis, was not as abundant as in 1965, and the stony coral, Paracyathus stearnsi, was not recorded from the area, while it was noted as common in 1965.

The 100-foot station at Transect II was in an area of 10 foot high rocky terraces in depths ranging from 60 to over 100 feet. The arc area was rocky, but covered with a fine sediment layer. There was no algal cover in the arc area, however, gorgonians, stony corals, the large red sponge, Trikentrion flabelliformis and many other smaller invertebrates were noted. Data from 1965 are not directly comparable because the 100-foot station was on a sandy bottom, while the extralimital observations covered rocky areas close to the arc, and species recorded there were about the same as those recorded during this survey. One exception is the abundance of fish (mainly rockfish species) recorded during the current survey, associated with the high relief terraces in the area. These fish are commonly found associated with high relief rock reefs at these depths in southern California.

The 100-foot station at Transect III was located at the base of a cliff on a sloping pavement-like rock area. The only algae reported

TABLE 6. Plants and Animals Recorded at 100-foot Depth Stations, Point Loma, June 1-10, 1972

Scientific name	Transect and abundance*			
	I	II	III	IV
ALGAE				
Agarum fimbriatum	(9)			
Bossiella sp.	(C)		(2)	
Codium sp.	(1)			
Cystoseira/Halidrys	(25)			
Laminaria farlowii	(1)			
Lithothamnion sp.	(A)			
Rhodophyta (unident.)		3		
Rhodymenia sp.	(2)			
PROTOZOA				
Foraminifera	((A))	[[P]]	[[P]]	
PORIFERA				
Porifera (unident.)	(8),[9]	(2)	(8)	P
Rhabdodermella nuttingi	(1),[14]			
Tethya aurantia		(1)		
Trikentrion flabelliformis		(5)		
CNIDARIA				
Abietinaria sp.	[[P]]			
Actinaria (unident.)	[1]			
Aglaophenia struthionides	P			
Astrangia lajollaensis	(C),[10]	45,(58)	(P)	
Balanophyllia elegans	(S)			
Coryanactis californica	(2)	(P)	(P)	P
Hydrozoa (unident.)	(P)			P
Lophogorgia chilensis	1	(3)	(1)	

TABLE 6. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Madreporaria imperforata		[[P]]		
Paracyathus stearnsii		[39]	(P)	P
Plummularia sp.	[P]			
NEMATODA				
Nematoda (unident.)	((A))	[3]		
NEMERTEA				
Nemertea (unident.)			[[P]]	
POLYCHAETA				
Ampharetidae (unident.)	((2))		[[P]]	
Aphrodite sp.		[1]		
Apomatus geniculata	[3]			
Arabella iricolor			[[P]]	
Armandia bioculata	((11))	[4]		
Cirratulidae (unident.)	((5))	[1]		
Diopatra ornata				A
Diopatra sp.	((3))			
Exogone lourei		[7]		
Glycera sp.	((4))		[[P]]	
Hemipodus sp.	((1))			
Hesionidae (unident.)	((2)),[[P]]		[[P]]	
Laonice cirrata			[[P]]	
Laonice sp.		[3]		
Lumbrineris sp.	((2))	[1]	[[P]]	
Maldanidae (unident.)	((1)),[1]	[1]		
Nereidae (unident.)	((1)),[1]	[1]		
Nereis sp.			[[P]]	

TABLE 6. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Odontosyllis phosphorea		[1]		
Ophiodromis pugetiensis		[2]	[[P]]	
Paleanotus bellis		[1]		
Paraonidae (unident.)	((1))			
Peisidice aspera	[[P]]	[8]	[3]	
Pherusa sp.		[1]		
Phyllodocidae (unident.)	((2))			
Polydora sp.		[1]		
Polynoidae (unident.)	[1]	[[2]]	[[2]]	
Prionospio malmgreni	((1))			
Sabellidae (unident.)	((1))	[1]		
Salmacina tribranchiata		(1)	(4)	
Scalibregma inflatum	((3))			
Serpulidae (unident.)	[[P]]			
Spionidae (unident.)		[1]		
Spiophanes bombyx	((2))			
Spirorbis moerchi		[1]		
Spirorbis sp.	[[P]]			
Syllidae (unident.)	((2)),[1]	[19]	[[P]]	
Terebellidae (unident.)		[1]		
Tharyx sp.	((1))			
CRUSTACEA				
Balanus sp.		[[P]]		
Caprellidea (unident.)	[5]	[5]		
Cumacea (unident.)	((13)),[1]	[14]		
Gammaridea (unident.)	((38)),[45]	[57]	[3]	

TABLE 6. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Hermit Crab (unident.)			(1)	1
Isopoda (unident.)	((7)),[1]			
Natantia (unident.)		[[P]]		
Ostracoda (unident.)	((2))	[1]		
Pycnogonidae (unident.)		[7]		
Pylopagurus minimus		(7)		
Shrimp (unident.)		[1]	[1]	
MOLLUSCA				
Alvinia sp.			[2]	
Astraea gibberosa	(1)			
Caecum dalli	((48))			
Caecum sp.	((62))		[2]	
Cancellaria cooperi	[1]			
Conus californicus	(4)	[1]		1
Crepidula sp.	[[P]]			
Dendrodoris fulva	1		(4)	
Dentalium sp.	((P))	[2]		
Flabellinopsis iodinea		(1)	(2)	2
Gastropoda (unident.)	((5))			2
Hinnites multirugosus	1	(1)		
Kelletia kelleti	(7)	(1)	(1)	1
Kelletia kelleti "eggs"		(P)		
Leptopecten sp.	[1]			
Lima hemphilli	[3]			
Lucinidae (unident.)		[[P]]		
Megasurcula sp.			(1)	

TABLE 6. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Megasurcula stearnsiana	[1]		[[P]]	
Mitra idae	[4]		[P]	
Mitra sp.			5	
Mopalia muscosa		[[P]]		
Mytilidae (unident.)		[3]		
Nassarina penicillata	((1))			
Nudibranchia (unident.)		[[P]]		1
Odostomia sp.	[3]			
Opisthobranchia (unident.)	[1]			
Pectinidae (unident.)	[[P]]	[1]		
Pelecypoda (unident.)	((16)),[1]		[9]	
Pitar newcombianus	[6]	[[P]]		
Pleurobranchus sp.		[[P]]		
Polinices sp.	((1))			
Polyplacophora (unident.)	[1]			
Pteropurpura trialiata	[[P]]	(1)		
Pteropurpura volksae	(1)			
Triotonia festiva		(1)	(1)	
Tricolia sp.	[1]			
Yoldia sp.	((300))			
BRYOZOA				
Antropora tincta		[[P]]		
Bryozoa (unident.)		2		
Diaperoecia californica		(2)	(1)	
Phidolopora pacifica			(1)	

TABLE 6. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
BRACHIOPODA				
Brachiopoda (unident.)		[8]		
ECHINODERMATA				
Astropecten verrilli	((1)),[2]			9
Cucumaria sp.	(1)			
Henricia leviuscula	2,[3]		(3)	
Linckia columbiae	(2)			
Lytechnius anamesus	(3)			
Mediaster aequalis		(2)		
Ophiuroidea (unident.)	((2)),[11]	[35]	[1]	
Parastichopus sp.	1	(1)		
Patiria miniata	4	(5)	(7)	
Strongylocentrotus franciscanus	1			
ASCIDIACEA				
Ascidiacea (unident.)				P
Boltenia villosa	(11)			
Styela montereyensis	(1)			
PISCES				
Branchiostoma californiense	((2))			
Caulolatilis princiceps			1	1
Chromis punctipinnis	P	25	P	
Clinidae (unident.)		1		
Coryphopterus nicholsi	(1)	10,(1)	1,(6)	9
Embiotoca jacksoni		1		
Hypsurus caryi	1			
Oxyjulis californica			P	

TABLE 6. (Continued)

Scientific name	Transect and abundance*			
	I	II	III	IV
Oxylebius pictus	(1)	1	(2)	
Pimelometopon pulchrum		2	P	1
Rathbunella sp.	3,(5)		2,(2)	
Sebastes carnatus	2	1	1,(1)	1
Sebastes caurinus	2		P	1
Sebastes constellatus		1		
Sebastes dalli	3,(2)	5	11,(1)	2
Sebastes miniatus				11
Sebastes mystinus	P,(1)	5		2
Sebastes rosaceus		5		1
Sebastes serranoides	1	5		
Sebastes serriceps		1		
Sebastes umbrosus	1			5
Trachurus symmetricus			P	

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* Abundance Symbols:

P = Present in the area but relative abundance not estimated.

S = Sparse - widely scattered throughout the area but nowhere numerous.

C = Common - unevenly present throughout the area and only occasionally numerous.

A = Abundant - numerous and evenly distributed throughout the area.

[] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.

() = Parentheses around the abundance symbol indicate occurrence within the arc study area.

[[]] = Double brackets around the abundance symbol indicate occurrence in diver pick-up within the arc study area.

(()) = Double parentheses around the abundance symbol indicate occurrence in the polychaete sample.

was Lithothamnium and a few sparse clumps of Bossiella. Encrusting bryozoans and sponges were the most prevalent invertebrates in the area while stony corals, gorgonians and molluscs were also present. There was a heavier covering of sediment recorded at this station than at any other. The area for this station in 1965 was sandy with large rocky outcrops and thus included some species associated with sand bottoms in addition to those found on rocky bottoms. More algae growth was noted in 1965 than during this survey.

A clean sand bottom with many boulders characterized the 100-foot station at Transect IV, compared to a bottom of boulders on a sandstone base encountered in 1965. Stony corals, polychaete worm tubes, sponges and several species of snails were common in the arc area. There was no algae recorded here during this survey whereas the report from 1965 notes the occurrence of low-growing reds and coralline algae.

EXTRALIMITAL SAMPLING

Three offshore stations (G-1, G-2, and G-3) were occupied near the terminus of the pipe on June 9 (Figure 1). These stations were sampled with a Ponar grab to attempt a comparison with the data previously reported (Turner, et al., 1968). It should be noted that no direct comparison of numbers can be made as the sampling device and the sample volumes are different. A tabulation of numbers and identifications is included (Table 7).

The presence of large numbers of the mollusc Parvalucina tenuisculpta at station G-2, with lower numbers to either side of the outfall, and the inverse pattern for the ophiuroid Amphiodia urtica supports other data showing this same relationship (J. Berry, San Diego RWQCB, pers. comm.).

TABLE 7. Animals Recorded from Ponar Grab Samples Taken Offshore from Point Loma, June 9, 1971

Scientific name	Station and Abundance		
	G-1	G-2*	G-3
NEMERTEA			
Nemertea (unident.)	3		2
POLYCHAETA			
Aglaophamus dicirris	1		1
Ampharetidae (unident.)			1
Cossura sp.	1		
Glycera sp.	2		5
Lumbrineris sp.	3		
Magelona pitelkai	2		
Nereidae (unident.)	1		1
Pectinaria californiensis	6		1
Spionidae (unident.)	1		
Terebellidae (unident.)			1
Tharyx multifilis	1		
Tharyx sp.			1
CRUSTACEA			
Caprellidea (unident.)	1		
Gammaridea (unident.)	1	3	2
Ostracoda (unident.)	3	6	
MOLLUSCA			
Acteocina sp.	5		1
Gastropoda (unident.)			1
Parvalucina tenuisculpta	14	444	65
Pectinidae (unident.)		10	

TABLE 7. (Continued)

Scientific name	Station and Abundance		
	G-1	G-2	G-3
Tellina idae			1
Tellinidae (unident.)		2	
Yolida sp.	2		
OPHIUROIDEA			
Amphiodia urtica	21		7

* The polychaetes from Station G-2 were lost before specific identification could be made.

The population densities of these two species may be influenced by the operation of the outfall, and further work should be done to define this relationship.

DISCUSSION

Studies of the marine environment off the western shore of Point Loma were conducted by biologists from the Department of Fish and Game during 1965. These studies were to evaluate any changes in the environment following 18 months operation of a submarine outfall. The present study was to compare present conditions with those found in 1965 and to further evaluate any changes in the marine environment which may have occurred due to operation of this ocean outfall.

Four intertidal and twenty subtidal stations were located as close as possible to the stations described in the 1965 report. However, many discrepancies arose in station location and less than half of the subtidal stations were located on the same substrate type. Although this method of station location for subtidal surveys proved unsatisfactory for direct comparison of population densities, there are general comparisons which can be made.

The intertidal areas on transects I and IV revealed an increased biotic diversity. Both transects were probably very close to the areas sampled in 1965 and were approximately the same length as those studied in 1965. Some of the increased species diversity may have come from identification of small organisms picked up incidentally with larger plants or animals. However, particularly with Transect I, the plant and animal populations seemed better established than reported for 1965. The intertidal portions of Transects II and III have been modified by the addition of structures to prevent further erosion of the cliffs and due to sea conditions we were able to sample only a portion of the intertidal

area at Transect II. The data presented here therefore cannot be directly compared to that reported in 1965. The intertidal zones observed along the four transects appeared healthy and in general compared favorably with the biota reported in 1965.

The stations located along the 20 foot depth strata appear to show an increased species diversity from those previously surveyed. This increase, however, may be due to small animals collected incidentally along with clumps of algae, etc. The most notable change since 1965 is the increase in several species of brown algae at some stations. Increases in some of these algal species have also occurred in other areas of southern California in the past three years, e.g., Palos Verdes. The 20-foot stations at Transects I and II were located on different substrates on the two occasions, precluding any direct comparisons.

Stations located at 40-foot depths generally revealed little change in invertebrate populations since 1965 except where substrate differences were noted. Although substrate change can occur through sand movements, the differences noted between these two surveys were more likely due to the method of station location. The increased abundance of low growing brown algae noted at 20-foot stations was also apparent at Transects I, III and IV along the 40-foot contour.

Species diversity at 60-foot depths generally appeared comparable to that noted in 1965. Although the species recorded for individual stations are not the same as those found in 1971, most of the larger invertebrate species were observed in the same relative abundance when the 60-foot stations are analyzed as a unit.

Dominance of low growing brown algae (Cystoseira/Halidrys, Pterygophora, Laminaria and Agarum) was noted at all stations in contrast to the small red algae recorded during the 1965 study. This difference was found even at

Transect II where sea urchins (a major herbivore) were recorded as abundant.

Our records of stations along the 80 foot contour show the same general substrate types as were found in 1965. The diversity of plant and animal life in these areas seems to have remained relatively stable although we did not record any red gorgonians (Lophogorgia chilensis) nor red urchins (Strongylocentrotus franciscanis), while these were noted as fairly common in 1965.

Extralimital observations (in the vicinity of each station) were more extensive in the 1965 survey and this is reflected in the observations of some animals which have patchy distributions. The absence of these species from our records may reflect some decrease in abundance rather than the complete absence of these animals.

Station descriptions given in 1965 are similar to those recorded in this study for 100 foot station areas. The substrate type in the arcs was not the same for all stations but extralimital observations make some comparisons between the two surveys possible. An increase in brown algae was noted at only one station (Transect I) while there was a decrease in red algae species at transects III and IV. The red gorgonian (Lophogorgia chilensis) was not as common during this survey and another gorgonian (Eugorgia rubens) was not recorded at all in 1971 while it was noted at 100-foot depths on all four transects in 1965.

The most obvious change in the inshore benthic environment off Point Loma between 1965 and 1971 has been an increase in several low growing brown algae observed at 20 to 60-foot depths. In addition to the change in algae abundance our data indicates a decrease in the occurrence of two gorgonian corals (Lophogorgia chilensis and Eugorgia rubens). These animals are thought to be long lived, fairly slow growing species and not subject to large population fluctuations. More thorough study is needed

to reveal any association between this possible population decrease or the increased algal growths and operation of the ocean outfall. The populations of the small clam (Parvalucina tenuisculpta) and the brittle star (Amphiodia urtica) likewise need further sampling and analysis of their population structure in relation to their proximity to the outfall. All other changes noted in a comparison of data from the two surveys could be attributable to slight differences in techniques of collection or processing of material. With changes in personnel involved, differences in the biologists ability to field identify animals and plants and also biologists abilities in laboratory identification of some groups makes comparisons of species lists very difficult. In addition very small changes in location of stations can reflect a dramatic change in species composition reported.

The survey techniques utilized in this study were not appropriate for evaluation of the giant kelp (Macrocystis pyrifera) resource off Point Loma. However, reports from the kelp habitat improvement project of California Institute of Technology show a substantial increase in the beds since 1965. Most of this increase has been in the northern portion of the beds corresponding with our Transects I and II. Much effort has been directed toward control of herbivore populations in the Point Loma area with destruction of urchins by both divers and quicklime applications. These operations have probably had some effect on the survival of many plant and animal species, but, increases in some low growing brown algae have been observed in some areas in southern California where herbivore control has not taken place e.g., Palos Verdes Peninsula.

SUMMARY

The subtidal area (into 100-foot depths) west of Point Loma, San Diego County, was visually surveyed by biologist-divers to ascertain the number

and diversity of marine life. These data were compiled for and will be used by, the San Diego Regional Water Quality Control Board in its evaluation of environmental changes (if any) which have occurred due to operation of an ocean outfall in this area.

Field work was conducted during June of 1971. Twenty diving stations and four intertidal areas were occupied along four transects lying perpendicular to shore from the intertidal into 100-foot depths. The stations were located in the same manner as those surveyed by the Department in 1965. Survey methods employed to quantitatively and qualitatively sample the animals and plants present were as close as possible to those used in the 1965 study. Animals and plants within a 15 square meter arc were enumerated. Quantitative sampling by actual removal of all organisms within a quadrat 0.25 m on a side was done and the organisms were identified and recorded.

Three ponar grab samples were taken in the 220-foot depths around the outfall terminus to compare with samples taken in 1965. The population densities of a small clam (Parvalucina tenuisculpta) and a brittle star (Amphiodia urtica) seemed influenced by distance from the outfall. This was not demonstrated in data collected in 1965, but, it may have taken several years for the discharge to effect a pattern of population density for these species.

Water visibility (clarity) was generally poor at the inshore stations, becoming more favorable at intermediate and offshore locations. Visibility at the station areas ranged from less than 1 foot (20-foot station, Transect III) to an estimated 30 feet at the 60-foot station on Transect IV.

Bottom temperatures ranged from 50°F at the 80 and 100-foot depths to 61°F at the 20-foot station on Transect II. The thermocline was generally between 20 and 40 feet deep at each station and was quite well defined. The temperature data taken in 1965 ranged from 54.1°F to 56.3°F.

These milder changes in temperature with depth are typical for southern California coastal areas in early spring while thermal stratification usually develops in May and June.

Our survey methods did not measure the abundance of giant kelp off Point Loma adequately, but other data demonstrates a considerable increase in the beds since 1965.

There is an indication of a moderate increase in several low growing brown algae in the 20 to 60-foot depths. In addition, our data reflects an apparent decrease in populations of two gorgonian species (Lophogorgia chilensis and Eugorgia rubens). Except for these instances the data in general follows the recorded species, numbers, and diversities of plants and animals found in 1965, however, it is very difficult to assess or evaluate changes in benthic animal populations with a survey of this type. The problem is basically one of sampling a very large, variable area with a small number of samples. The only data that can be duplicated is in the form of general descriptions of the station areas. One can relate these descriptions to the general area but the relative abundance of organisms has reference to only the station sampled and could be quite different just a short distance away. Likewise any species or community recorded extralimitally is not as apt to be included if a smaller area is searched.

In conclusion, the value of general descriptive information of large areas to a survey of this type is greater than was previously anticipated. Quantitative data for use in comparisons should be limited to either more uniform habitat types (as at the discharge site on a sand bottom in 220 feet of water) and sampling methods (using the same type of grabs) or to permanent stations in the nearshore rocky areas. A properly designed random sampling plan might produce meaningful quantitative data, but it is doubtful if we could ever occupy a sufficient number of random stations in

an area the size of Point Loma to achieve statistical significance.

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APPENDIX I

Physical Data for 24 Stations Occupied During a Survey of the Marine Environment Offshore From Point Loma, June 1971

Station	Date	Depth (ft.)	Bottom Temp. (°C)	Bottom visibility diver est. (ft.)	Remarks
Transect I					
IT	6/3/71	Intertidal	-	-	Transect 90 feet long, extending down sandstone shelves.
20	6/7/71	20	60.0	6	Rock outcroppings from sand bottom, 1 1/2-foot relief.
40	6/7/71	40	53.0	15-20	Sand
60	6/6/71	60	51.0	15	Large rock outcroppings surrounded by sand.
80	6/6/71	80	50.5	20	Thin layer of sand over pavement rock.
100	6/6/71	95	50.0	5-10	Flat pavement with sand intrusion.
Transect II					
IT	6/16/71	Intertidal	-	-	Transect 50 feet long, modified by man.
20	6/3/71	20	61.0	7	Sand with rock outcroppings.
40	6/2/71	40	55.0	20	Sand with rock outcroppings.
60	6/7/71	60	51.0	25	Rock with 2-foot relief.
80	6/3/71	80	50.0	20	Flat rocky with occasional car-sized boulders.
100	6/2/71	100	50.0	15-20	Shelfing ledges with 10-foot drops covered with fine layer of sediment.

APPENDIX I. (Continued)

Station	Date	Depth (ft.)	Bottom temp. (°C)	Bottom visibility diver est. (ft.)	Remarks
Transect III					
IT	6/15/71	Intertidal	-	-	Transect 50 feet long, modified by man.
20	6/8/71	20	60.0	0.5	Heavy surge, no visibility. Sand with cobble.
40	6/8/71	40	51.8	20	Heavy surge, low relief rock.
60	6/5/71	60	51.0	20	Flat sandstone with sand patches.
80	6/5/71	84	50.0	20	Flat rock with loose sediment.
100	6/5/71	100	50.0	15-20	Base of cliff with flat pavement rock covered with heavy sediment layer.
Transect IV					
IT	6/3/71 6/15/71	Intertidal	-	-	Transect 300 feet long across sandstone shelves to base of cliffs.
20	6/8/71	20	59.0	5	Flat mudstone terrace with coarse sand cover in spots.
40	6/4/71	40	52.0	15	Flat mudstone with sandy-shelly debris
60	6/4/71	60	51.0	30	Rocky bottom with some high relief.
80	6/4/71	80	50.0	20-25	Sand and boulders.
100	6/4/71	110	50.0	20	Clean sand with many boulders.

APPENDIX II

Scientific and Common Names of Plants and Animals Observed Offshore From Point Loma, June 1971

Scientific name	Common name
ALGAE	
Acrosorium sp.	red algae
Agarum fimbriatum Harvey	brown algae
Ahnfeltia plicata (Hudson)	red algae
Bossiella californica (Decaisne)	coralline algae
Bossiella orbigniana (Decaisne)	coralline algae
Bossiella sp.	coralline algae
Bryopsis corticulans Setchell	green algae
Callithamnion sp.	red algae
Codium sp.	green algae
Colpomenia sinuosa (Roth)	brown algae
Colpomenia sp.	brown algae
Corallina gracilis Lamouroux	coralline algae
Corallina vancouverensis Yenda	coralline algae
Corallina sp.	coralline algae
Cystoseira/Halidrys	brown algae (not able to separate)
Dictyopteris zonarioides Farlow	brown algae
Dictyota flabellata (Collins) Setchell and Gardner	brown algae
Egregia laevigata Setchell	feather boa
Eisenia arborea Areschoug	Southern Sea palm
Enteromorpha sp.	green algae
Gelidium cartilagenum Gardner	red algae
Gelidium coulteri Harvey	red algae
Gelidium sp.	red algae
Gigartina boryi Setchell and Gardner	red algae
Gigartina caniculata Harvey	red algae
Gigartina papillata (C.A.Agardh) J. G. Agardh	red algae
Gigartina sp.	red algae
Laminaria farlowii Setchell	ribbon kelp
Laurencia sp.	red algae
Lithothamnion sp.	coralline algae
Lithothrix aspergillum J. E. Gray	coralline algae
Macrocystis pyrifera (Linnaeus) C. Agardh	giant kelp
Nemalion lubricum Duby	red algae
Pelagophycus porra (Leman) Setchell	elk kelp
Pelvetia fastigata (J. Agardh) G. De Toni	brown algae
Peyssonelia sp.	red algae
Plocamium pacificum Kylin	red algae
Pterocladia sp.	red algae
Pterygophora californica Ruprecht	brown algae
Ralfsia sp.	brown algae

APPENDIX II. (Continued)

Scientific name	Common name
Rhodoglossum parvum G. M. Smith and Hollenberg	red algae
Rhodophyta (unident.)	red algae
Rhodymenia sp.	red algae
Sargassum sp.	brown algae
Ulva sp.	green algae
ANTHOPHYTA (Flowering marine plants	
Phyllospadix torreyi S. Watson	surf grass
PROTOZOA	
Foraminifera	armored protozoan
PORIFERA	
Craniella arb de Laubenfels	sponge
Leuconia sp.	sponge
Porifera (unident.)	sponge
Rhabdodermella nuttingi Urban	urn sponge
Spheciospongia confoederata deLaubenfels	liver sponge
Tethya aurantia (Passas)	orange puff-ball sponge
Trikentrion flabelliformis Hentschel	leaf sponge
CNIDARIA	
Abietinaria sp.	hydrozoan
Aglaophenia diegensis Torrey	ostrich plume hydrozoan
Aglaophenia struthionides (Murray)	ostrich plume hydrozoan
Aglaophenia sp.	ostrich plume hydrozoan
Actinaria (unident.)	sea anemones (order)
Anthopleura elegantissima (Brandt)	aggregate anemone
Anthopleura xanthogrammica (Brandt)	solitary anemone
Anthopleura sp.	anemone
Astrangia lajollaensis Durham	aggregate coral
Balanophyllia elegans Verrill	solitary coral
Campanularia sp.	hydrozoan
Cerianthidae (unident.)	tube anemone
Coryanactis californica Carlgren	aggregate anemone
Epiactis prolifera Verrill	prolific anemone
Hydrozoa (unident.)	hydrozoan
Lophogorgia chilensis (Verrill)	pink gorgonian
Muricea californica Verrill	gorgonian
Paracyathus stearnsii Verrill	solitary coral
Plumularia sp.	plumed hydrozoan
Renilla kollikeri Pfeffer	sea pansy
Sertularella turgida (Trask)	hydrozoan

APPENDIX II. (Continued)

Scientific name	Common name
Tealia lofotensis (Danielssen)	anemone
Tealia sp.	anemone
NEMATODA	
Nematoda (unident.)	nematod worm
NEMERTEA	
Nemertea (unident.)	nemertean worm
POLYCHAETA	
Ampharetidae (unident.)	polychaete worm
Aphrodite sp.	" "
Apomatus geniculata (Moore and Bush)	" "
Arabella iricolor (Montagu)	" "
Armandia bioculata Hartman	" "
Boccardia sp.	" "
Chaetopteridae (unident.)	" "
Chloeia pinnata Moore	" "
Chone sp.	" "
Chrysopetalidae (unident.)	" "
Cirratulidae (unident.)	" "
Dasybranchus sp.	" "
Diopatra ornata Moore	" "
Diopatra sp.	" "
Eudistylia polymorpha (Johnson)	feather duster worm
Eudistylia vancouveri (Kinburg)	feather duster worm
Eunice antennata (Savigny)	polychaete worm
Eunice sp.	" "
Eunicidae (unident.)	" "
Euphrosine aurantiaca Johnson	" "
Eupomatus gracilis Bush	" "
Eusyllis transecta Hartman	" "
Exogone lourei Berkley and Berkeley	" "
Exogone sp.	" "
Flabelliderma commensalis (Moore)	" "
Glycera sp.	" "
Halosydna johnsoni (Darboux)	scale worm
Halosydna sp.	scale worm
Hemipodus sp.	polychaete worm
Hesionidae (unident.)	" "
Laonice cirrata (Sars)	" "
Laonice sp.	" "
Lepidonotus sp.	" "
Lumbrineris sp.	" "
Maldanidae (unident.)	" "
Naineris dendritica (Kinburg)	" "
Nereidae (unident.)	" "

APPENDIX II. (Continued)

Scientific name	Common name	
Nereis sp.	polychaete worm	
Nothria sp.	"	"
Odontosyllis parva Berkeley	"	"
Odontosyllis phosphorea Moore	"	"
Oncoscolex pacificus (Moore)	"	"
Onuphidae (unident.)	"	"
Opheliidae (unident.)	"	"
Ophiodromus pugettiensis (Johnson)	"	"
Paleanotus bellis (Johnson)	"	"
Paleanotus sp.	"	"
Palola paloloides (Moore)	"	"
Paraonidae (unident.)	"	"
Pectinaria sp.	"	"
Peisidice aspera Johnson	"	"
Pherusa inflata (Treadwell)	"	"
Pherusa sp.	"	"
Phragmatopoma californica (Fewkes)	"	"
Phyllodocidae (unident.)	"	"
Pilargidae (unident.)	"	"
Pista sp.	"	"
Polychaeta (unident.)	"	"
Polydora sp.	"	"
Polynoidae (unident.)	"	"
Prionospio malmgreni Claparede	"	"
Sabellaria cementarium Moore	"	"
Sabellaria sp.	"	"
Sabellidae (unident.)	"	"
Salmacina tribranchiata (Moore)	"	"
Scalibregma inflatum Rathke	"	"
Serpula vermicularis Linnaeus	"	"
Serpulidae (unident.)	"	"
Spionidae (unident.)	"	"
Spiophanes bombyx (Claparede)	"	"
Spiophanes missionensis Hartman	"	"
Spirobranchus spinosus Moore	"	"
Spirorbis borealis Daudin	"	"
Spirorbis eximius Bush	"	"
Spirorbis moerchi Levinsen	"	"
Spirorbis sp.	"	"
Syllidae (unident.)	"	"
Syllis gracilis Grube	"	"
Terebella californica Moore	"	"
Terebellidae (unident.)	"	"
Thalenessa spinosa (Hartman)	"	"
Tharyx multifilis Moore	"	"
Tharyx sp.	"	"
Typosyllis fasciata (Malmgren)	"	"
Typosyllis sp.	"	"

APPENDIX II. (Continued)

Scientific name	Common name
SIPUNCULIDA	
Sipunculida (unident.)	peanut worm (phylum)
CRUSTACEA	
Balanus sp.	barnacle
Cancer jordani Rathbun	hairy cancer crab
Cancer sp.	crab
Caprellidea (unident.)	skeleton shrimp (suborder)
Cryptolithodes sitchensis Brandt	umbrella crab
Cumacea (unident.)	Arthropod (order)
Decapoda (unident.)	crabs and shrimp
Gammaridea (unident.)	Amphipod (suborder)
Isopoda (unident.)	Isopod (order)
Loxorhynchus crispatus Stimpson	masking crab
Loxorhynchus sp.	spider crab
Ostracoda (unident.)	crustacean (subclass)
Pachycheles rudis Stimpson	big clawed porcelain crab
Paguridae (unident.)	hermit crab
Pagurus sp.	hermit crab
Panulirus interruptus (Randall)	spiny lobster
Pentidotea aculeata Stafford	isopod
Pycnogonida (unident.)	sea spider
Pylopagurus minimus (Holmes)	hermit crab
MOLLUSCA	
Acanthochitona avicula (Carpenter)	chiton
Acmaeidae (unident.)	limpet
Acteocina sp.	snail
Acteon punctocoelatus (Carpenter)	barrel shell
Adula diegensis (Dall)	San Diego pea-pod
Alvinia sp.	snail
Anisodoris nobilis (MacFarland)	corid nudibranch
Astraea gibberosa Dillwyn	turban snail
Astraea undosa Wood	turban snail
Astraea sp.	turban snail
Barleeia sp.	rissoid snail
Bittium sp.	snail
Cadlina limbaughi Lance	dorid nudibranch
Cadlina luteomarginata MacFarland	dorid nudibranch
Caecum dalli Bartsch	snail
Caecum sp.	snail
Calliostoma sp.	trochid snail
Callistochiton crassicostatus Pilsbry	chiton
Cancellaria cooperi Gabb	Cooper's nutmeg
Cardiidae (unident.)	cockles (family)
Chaceia ovoidea (Gould)	wart-necked piddock
Chama pellucida Sowerby	agate chama

APPENDIX II. (Continued)

Scientific name	Common name
Chione undatella (Sowerby)	wavy chione
Conus californicus Hinds	California cone
Crassispira semiiflata (Grant and Gale)	snail
Crepidula aculeata (Gmelin)	spiny slipper shell
Crepidula norrisiarum Williamson	slipper shell
Crepidula sp.	slipper shell
Cyanoplax hartwegii (Carpenter)	Hartwegs chiton
Cyanoplax sp.	chiton
Cylichna sp.	snail
Cypraea spadicea Swainson	chestnut cowry
Cystiscus sp.	snail
Dendrodoris fulva (MacFarland)	yellow sea slug
Dendropoma sp.	worm shell
Dentalium sp.	tooth shell
Dialula sandiegensis (Cooper)	dorid nudibranch
Donax sp.	bean clam
Epitonium tinctum (Carpenter)	tinted wentletrap
Fissurelidae (unident.)	keyhole limpet
Flabellinopsis iodinea (Cooper)	aeolid nudibranch
Fusinidae (unident.)	spindle shell
Gastropoda (unident.)	snails
Haliotis assimilis Dall	threaded abalone
Hiatella arctica (Linnaeus)	rough nestling clam
Hinnites multirugosus (Gale)	rock scallop
Hipponix antiquatus (Linnaeus)	hoof shell
Homalopoma sp.	snail
Kelletia kelletii Forbes	whelk snail
Kelletia kelletii "eggs"	egg cases
Kellia laperousi (Deshayes)	nestling clam
Lepidozona californiensis Berry	chiton
Leptopecten sp.	scallop
Lima hemphilli Hertlein and Strong	file shell
Lithophaga plumula (Hanley)	date mussel
Lucinidae (unident.)	clam
Macoma sp.	clam
Maxwellia santarosana (Dall)	Santa Rosa murex
Maxwellia sp.	murex
Megasurcula sp.	turrid snail
Megasurcula stearnsiana (Raymond)	Stearns' turrid
Megathura crenulata Sowerby	giant keyhole limpet
Mitra idae Melville	miter snail
Mitra sp.	miter snail
Mitrella aurantiaca (Dall)	dove shell
Mitrella carinata (Hinds)	carinate dove shell
Mitrella gausapata Gould	dove shell
Mitrella tuberosa (Carpenter)	dove shell
Mopalia muscosa (Gould)	chiton
Mopalia porifera Pilsbry	chiton
Mytilus californianus Conrad	California mussel
Mytilus edulis Linnaeus	bay mussel

APPENDIX II. (Continued)

Scientific name	Common name
Mytilidae (unident.)	mussel
Nassarina penicillata (Carpenter)	pencilled dove shell
Nassarius perpinguis (Hinds)	fat nassa
Natacidae (unident.)	moon snails
Netastoma sp.	boring clam
Norrissia norrissi Sowerby	trochid snail
Notoacmaea paleacea (Gould)	limpet
Notoacmaea sp.	limpet
Nudibranchia (unident.)	sea slug
Oceanebra foveolata (Hinds)	snail
Octopus sp.	octopus
Odostomia sp.	snail
Olivella biplicata Sowerby	olive snail
Olivella sp.	olive snail
Ophiodermella ophioderma (Dall)	snail
Opisthobranchia (unident.)	sea slug
Pectinidae (unident.)	scallop
Pelecypoda (unident.)	clam
Penitella penita (Conrad)	flat-tipped piddock
Pholadidae (unident.)	boring clam
Pitar newcombianus (Gabb)	clam
Pleurobranchus sp.	sea slug
Megatebennus bimaculutus (Dall)	two spotted keyhole limpet
Pododesmus cepio (Gray)	abalone jingle
Polinices lewisii (Gould)	Lewis' moon snail
Polinices sp.	moon snail
Polyplacophora (unident.)	chiton
Pseudomelatoma torosa Carpenter	knobbed tower-shell
Pteropurpura festiva (Hinds)	festive murex
Pteropurpura trialiata (Sowerby)	three-winged murex
Siphonariidae (unident.)	snail (family)
Tagelus sp.	jackknife clam
Tectibranchia (unident.)	sea slug
Tegula eiseni Jordan	bonded tegula (snail)
Tegula funebralis (A. Adams)	black tegula (snail)
Tegula sp.	snail
Tellina sp.	clam
Trivia solandri (Sowerby)	solanders trivia
Turbinidae (unident.)	snail
Tricolia sp.	snail
Tylodina sp.	limpet
Ventricolaria fordi (Yates)	clam
Williamina peltoides (Carpenter)	cap shell
Yoldia sp.	clam
BRYOZOA	
Antropora tincta (Hastings	bryozoan
Bryozoa (unident.)	bryozoan
Crisia sp.	bryozoan
Crisiidae (unident.)	bryozoan
Diaperoecia californica (d'Orbigny)	bryozoan

APPENDIX II. (Continued)

Scientific name	Common name
Phidolopora pacifica (Robertson)	lacy bryozoan
BRACHIOPODA	
Terebratalia transversa (Sowerby)	lamp shell
ECHINODERMATA	
Asteroidea (unident.)	sea star
Astrometis sertulifera (Xantus)	sea star
Astropecten verrilli de Loriol	sand star
Cucumaria sp.	sea cucumber
Dermasterias imbricata (Grube)	leather star
Henricia leviuscula (Stimpson)	sea star
Holothuroidea (unident.)	sea cucumber
Linckia columbiae Gray	sea star
Lytechinus anamesus H. L. Clark	white sea urchin
Mediaster aequalis Stimpson	sea star
Ophiuroidea (unident.)	brittle star
Orthasterias koehleri (deLoriol)	sea star
Parastichopus parvimensis (Clark)	sea cucumber
Parastichopus sp.	sea cucumber
Patiria miniata (Brandt)	bat star
Pisaster brevispinnus (Stimpson)	sea star
Pisaster giganteus (Stimpson)	sea star
Pisaster sp.	sea star
Scelasterias heteropaes Fisher	sea star
Strongylocentrotus franciscanus (Agassiz)	red sea urchin
Strongylocentrotus purpuratus (Stimpson)	purple sea urchin
Strongylocentrotus sp.	sea urchin
ASCIDIACEA	
Ascidiacea (unident.)	compound ascidian
Ascidia ceratodes (Huntsman)	solitary ascidian
Boltenia villosa (Stimpson)	solitary ascidian
Chelyosoma macleayanum Broderip and Sowerby	solitary ascidian
Styela montereyensis (Dall)	solitary ascidian
PISCES	
Artedius sp.	
Branchiostoma californiense (Cooper)	Amphioxus or Lancelet
Caulolatilis princiceps (Jenyns)	ocean whitefish
Chromis punctipinnis (Cooper)	blacksmith
Coryphopterus nicholsi (Bean)	bluespot goby
Embiotica jacksoni Agassiz	black perch
Gibbonsia sp.	kelp fish
Girella nigricans (Ayres)	opaleye

APPENDIX II. (Continued)

Scientific name	Common name
Halichoeres semicinctus (Ayres)	rock wrass
Hypsurus caryi (Agassiz)	rainbow seaperch
Myliobatis californicus Gill	bat ray
Neoclinus stephensae Hubbs	yellowfin fringehead
Orthonopias triacis Starks and Mann	cottid
Oxyjulis californica (Gunther)	senorita
Oxylebius pictus Gill	painted greenling
Paralabrax clathratus (Girard)	kelp bass
Paralabrax nebulifer (Girard)	barred sand bass
Phanerodon furcatus Girard	white sea perch
Pimelometopon pulchrum Ayres	California sheephead
Pleuronichthys coenosus Girard	C - O turbot
Rathbunella sp.	ronquil
Rhacochilus vacca (Girard	pile perch
Scorpaena guttata Girard	sculpin (California scorpionfish)
Scorpaenichthys marmoratus (Ayres)	cabezon
Sebastes atrovirens (Jordan and Gilbert)	kelp rockfish
Sebastes auriculatus Girard	brown rockfish
Sebastes carnatus (Jordan and Gilbert)	gopher rockfish
Sebastes caurinus (Richardson)	copper rockfish
Sebastes constellatus (Jordan and Gilbert)	starry rockfish
Sebastes dalli (Eigenmann & Beeson)	calico rockfish
Sebastes miniatus (Jordan and Gilbert)	vermillion rockfish
Sebastes mystinus (Jordan and Gilbert)	blue rockfish
Sebastes rosaceus Jordan and Gilbert	rosy rockfish
Sebastes sp. (juv.)	unidentified juvenile rockfish
Sebastes serranoides Eigenmann & Eigenmann	olive rockfish
Sebastes serriceps (Jordan & Gilbert)	treefish
Sebastes umbrosus (Jordan & Gilbert)	honeycomb rockfish
Sebastes vexillaris (Jordan & Gilbert)	whitebelly rockfish
Trachurus symmetricus (Ayres)	jack mackerel